ORTEC
INCORPORATED
AN EG&G COMPANY

Model 9302
Amplifier-Discriminator

Operating and Service Manual

MP MASTER
MA29078

SUBJECT: ORTEC MODEL 9302 AMPLIFIER-DISCRIMINATOR MODULE--REFER TO ECN #3 AND ECN #4

On schematic 9302-0101-S1, add the following:

1) 270pF capacitor, C82, from Q8 collector to ground.

2) Ferrite bead, L14, in series with Q7 base.

ORTEC

Model 9302
Amplifier-Discriminator

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This manual applies to instruments
"Rev 01" (on rear panel)

Printed in U.S.A.

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STANDARD WARRANTY FOR ORTEC INSTRUMENTS

ORTEC warrants its instruments other than preamplifier FET input transistors, vacuum tubes, fuses, and batteries to be free from defects in workmanship and materials for a period of twelve months from date of shipment provided that the equipment has been used in a proper manner and not subjected to abuse. Repairs or replacement, at ORTEC option, will be made on in-warranty instruments, without charge, at the ORTEC factory. Shipping expense will be to the account of the customer except in cases of defects discovered upon initial operation. Warranties of vacuum tubes and semiconductors made by their manufacturers will be extended to ORTEC customers only to the extent of the manufacturers' liability to ORTEC. Specially selected vacuum tubes or semiconductors cannot be warranted. ORTEC reserves the right to modify the design of its products without incurring responsibility for modification of previously manufactured units. Since installation conditions are beyond the company's control, ORTEC does not assume any risks or liabilities associated with methods of installation or with installation results.

QUALITY CONTROL

Before being approved for shipment, each ORTEC instrument must pass a stringent set of quality control tests designed to expose any flaws in materials or workmanship. Permanent records of these tests are maintained for use in warranty repair and as a source of statistical information for design improvements.

REPAIR SERVICE

If it becomes necessary to return this instrument for repair, it is essential that Customer Services be contacted in advance of its return so that a Return Authorization Number can be assigned to the unit. Also, ORTEC must be informed, either in writing or by telephone [(615) 482-4411], of the nature of the fault of the instrument being returned and of the model, serial, and revision ("Rev" on rear panel) numbers. Failure to do so may cause unnecessary delays in getting the unit repaired. The ORTEC standard procedure requires that instruments returned for repair pass the same quality control tests that are used for new-production instruments. Instruments that are returned should be packed so that they will withstand normal transit handling and must be shipped **PREPAID** via Air Parcel Post or United Parcel Service to the nearest ORTEC repair center. The address label and the package should include the Return Authorization Number assigned. Instruments being returned that are damaged in transit due to inadequate packing will be repaired at the sender's expense, and it will be the sender's responsibility to make claim with the shipper. Instruments not in warranty will be repaired at the standard charge unless they have been grossly misused or mishandled, in which case the user will be notified prior to the repair being done. A quotation will be sent with the notification.

DAMAGE IN TRANSIT

Shipments should be examined immediately upon receipt for evidence of external or concealed damage. The carrier making delivery should be notified immediately of any such damage, since the carrier is normally liable for damage in shipment. Packing materials, waybills, and other such documentation should be preserved in order to establish claims. After such notification to the carrier, please notify ORTEC of the circumstances so that assistance can be provided in making damage claims and in providing replacement equipment if necessary.

ORTEC®
9302
AMPLIFIER
DISCRIMINATOR
GAIN
200
20
DISC LEVEL
50mV-1V
MONITOR
RATE DISC
10K
100K
1K
1M
TEST POINTS
AMP
DISC
MON
+12V 140mA
-12V 205mA
+24V 85mA
-24V 90mA
SER.
AMPLIFIER IN
DISC. OUT
AMP.
OUT
SIGNAL
MON.
PREAMP POWER
MODEL 9302

ORTEC MODEL 9302 AMPLIFIER-DISCRIMINATOR

1. DESCRIPTION

1.1. GENERAL

The ORTEC 9302 is a fast amplifier and discriminator in a single-wide NIM-standard module designed for use with photomultiplier or electron multiplier tubes in photon, ion, or electron counting applications. Features of the 9302 include a wideband, high-gain amplifier and an integral discriminator capable of counting rates up to 100 MHz.

Incorporated in the module is a rate monitor system that can be used to perform external switching when the pulse counting rate is modulated. At counting rates **above** those set by the front panel selector switch, a voltage of greater than 2.0 V will be present at the signal monitor connector. At counting rates below the rate selected, 0 ± 0.2 V will be present at the signal monitor connector.

1.2. INPUT SIGNALS

The input signals are ac-coupled into an impedance of 50Ω. The maximum amplitude range of the amplifier to retain linearity is 50 mV when the gain switch is set at X20 and is 5 mV when the gain switch is set at X200. Protection is provided for input voltages of up to ±100 V at a 10% duty cycle.

1.3. OUTPUTS

The linear amplifier output connector is located on the rear panel of the module and has an output impedance of 50Ω. Use of this output requires 50Ω coaxial cable and 50Ω termination.

Two discriminator output connectors are also located on the rear panel of the module. They are isolated from each other and produce a negative current pulse of 16 mA into a 50Ω load impedance. The output pulse width is ≤5.0 ns.

The rear panel signal monitor connector produces a positive dc voltage when the counting rate after the discriminator is greater than the rate selected on the front panel for the monitor rate discriminator. When the counting rate is below the selected rate, 0 ± 0.2 V appears at the signal monitor output.

2. SPECIFICATIONS

2.1. PERFORMANCE

AMPLIFIER

Voltage Range 0 to 50 mV.

Rise Time Typically 3.0 ns.

Noise ≤10 μV for maximum gain.

Gain Switch-selectable, X20 or X200.

Nonlinearity ≤±1%.

Temperature Instability Gain, <0.1%/°C; dc drift, <50 μV/°C.

DISCRIMINATOR

Threshold Range 50 mV to 1 V.

Walk ≤2.0 ns from X2 to X20 threshold.

Pulse Pair Resolution <10 ns; 9 ns typically.

2.2. CONTROLS

Gain Slide switch for selection of X20 or X200.

Disc Level Multiturn control adjusts the discriminator level from 50 mV to 1 V.

Monitor Rate Disc Front panel potentiometer selects 1 kHz, 10 kHz, 100 kHz, or 1 MHz, which determines the rate above which a logic level will be produced.

2.3. INPUT

Amplifier In BNC connector on rear panel accepts negative input signals; protected to ±100 V at 10% duty factor; Z_{in} = 50Ω.

2.4. OUTPUTS

Amp Out Rear panel BNC connector provides linear analog output; $Z_o = 50\Omega$.

Disc Out 2 independent BNC connectors on rear panel provide negative current pulse of 16 mA into 50Ω; width, ≤5 ns; rise time, 1.5 ns.

Signal Mon BNC connector on rear panel provides 0 ± 0.2 V when discriminator count rate is below threshold and ≥+2.0 V when it is above threshold.

Preamp Power Amphenol type 17-10090 connector on rear panel; provides necessary power for 9301 Fast Preamplifier.

2.5. ELECTRICAL AND MECHANICAL

Power Required

−24 V, 90 mA; −12 V, 205 mA;
+24 V, 85 mA; +12 V, 140 mA.

Dimensions NIM-standard single-width module (1.35 by 8.714 in.) per TID-20893.

3. INSTALLATION

3.1. GENERAL

Since the 9302, in conjunction with an ORTEC 401A/402A Bin and Power Supply, is intended for rack mounting, vacuum tube equipment operating in the same rack must be sufficiently cooled with circulating air to prevent any localized heating of the all-transistorized circuitry used throughout the 9302. The temperature of equipment mounted in racks can easily exceed the recommended maximum limit of 120°F (50°C) unless these precautions are taken.

3.2. CONNECTION TO POWER

The 9302 contains no internal power supply, and must obtain the necessary dc operating power from the 401A/402A Bin and Power Supply in which it is installed for operation. Always turn off power on the Power Supply before inserting or removing modules. The ORTEC 9000 Series of modular instruments is designed so that the Power Supply cannot be overloaded when there is a full complement of modules in the Bin. Since, however, this may not be true when the Bin contains modules other than those of ORTEC design, use the convenient test points on the front panel of the 401A/402A to check each Power Supply voltage level after all modules have been inserted.

3.3. INPUT/OUTPUT CONNECTIONS

The low input impedance (50Ω) and low output impedance (50Ω) of the 9302 permit it to be used in a system using only 50Ω cable. The low output impedance requires that the output cable be terminated by the characteristic impedance of the cable at the remote cable end.

4. CIRCUIT DESCRIPTION

4.1. AMPLIFIER SECTION

The 9302 amplifier section has a gain of 20 or 200, which is selectable by a front panel switch. When a gain of 20 is desired, the amplifier input signal is fed through R20 to the base of Q5. Q5 and Q6 form a long-tailed pair, with R23 serving as the current source for the pair. The base-emitter junction of Q7 is driven differentially by the collectors of Q5 and Q6. Q8 serves as an emitter-follower amplifier output stage. Overall negative voltage feedback is accomplished for the gain-of-20 stage by means of R30 and R27. The closed-loop voltage gain of this amplifier stage is approximately (R27 + R30)/R27. The output offset voltage of the X20 amplifier stage can be zero-adjusted by means of R31. R31 is a 22-turn potentiometer located at the top of the printed circuit board.

When a gain of 200 is desired, the front panel switch S1 may be positioned in the X200 position. This cascades a gain-of-10 amplifier stage with the gain-of-20 stage. The two gain stages are ac-coupled by capacitors C43, C44, and C47. The X10 gain stage has the same basic configuration as

the X20 gain stage and functions identically. The closed-loop gain of X10 stage is determined by the ratio (R10 + R13)/R10. The output offset voltage of the X10 gain stage can be zero-adjusted by means of resistor R12. R12 is a 22-turn potentiometer located at the top of the printed circuit board.

4.2. DISCRIMINATOR SECTION

The output of the X20 amplifier stage is ac-coupled to the input of the discriminator section. The amplifier output signal is fed through capacitor C51, resistor R42, and capacitor C22 to the common-base stage Q13. Q14, R43, and R44 bias and compensate the base of Q13. C23 by-passes the base of Q13 for high-speed signals. The signal out of the collector of Q13 is fed through R45 to the emitter of another common-base stage, Q15.

The resistor string R46, R126, and R47 carries the bias current from Q13 and Q15. Since the current in Q13 is set by the bias on Q13's base and may be assumed to be constant under quiescent conditions, the bias current in Q15 may be varied by means of R47. R47 is a 22-turn 100Ω potentiometer located at the top of the printed circuit board. The variation of bias current in Q15 causes a corresponding variation of bias current in tunnel diode D12 and the resistor string R49, R127, and R128. Hence R47 serves as a threshold calibration potentiometer. Once R47 is set, the bias current in Q15 should be constant under quiescent conditions. The bias current in D12 can then be varied by the threshold potentiometer R128. R128 is a 22-turn, 10-kΩ screwdriver-adjustable front panel potentiometer. Bias on the base of Q15 is maintained by D11 and R48.

The bias values from the input of the discriminator to tunnel diode D12 are such that each 50-mV increment in a signal excursion corresponds to approximately 1 mA of current delivered from diode D12. Since D12 is a 20-mA diode, a discriminator input range of −50 mV to −1.0 V can be accepted.

Q21 is normally conducting and Q22 is off under quiescent conditions. When the discriminator input signal is sufficient to switch the tunnel diode at a particular threshold setting, Q21 is turned off and Q22 is turned on. Q24 (normally on under quiescent condition) turns off. The negative-going signal at the collector of Q24 is differentiated by L7 and ac-coupled by C54 to pin 11 of IC1(14). The signal is amplified by IC1(14), IC1(15), and IC1(2). Delay cable DL1 and capacitor C63 couple the signal to pins 6 and 7 of IC1(3). The signal from IC1(2), pin 2, arrives at pin 6 of IC1(3), a time t_d (determined by DL1) later than the signal arrives at pin 7 of IC1(3). Hence, the signal occurring at pin 3 of IC1(3) is approximately 4.5 ns wide regardless of the input signal pulse width. IC1(3) drives the output current-switching pairs (Q25, Q26) and (Q27, Q28). Base reference bias for Q26 and Q28 is provided by Q30 and its associated circuitry. Two discriminator outputs are simultaneously available at CN2 and CN3 output connectors on the rear panel. A front panel discriminator test point is provided from Out A through R87.

The tunnel diode reset and hysteresis control circuit functions as follows: Q23 is normally off under quiescent conditions, and Q24 is on. When tunnel diode D12 changes from its low state to the high state, Q23 turns on. The amount of current delivered by Q23 is controlled by R80, and effectively determines the hysteresis of the tunnel diode circuit. R80 is a 22-turn, 2-kΩ potentiometer mounted at the top of the printed circuit board.

4.3. RATE MONITOR CIRCUIT

The signal to drive the rate monitor circuit is picked off the collector of Q28, fed through R119 and Q29, and level-shifted by means of R121 and R105. The negative-going signal is applied to pin 12 of IC3, which is normally approximately −1 V quiescently. Pin 13 of IC3 is approximately −1.7 V quiescently. The negative-going signal at pin 12 of IC3 results in a positive-going signal on IC3(15) and a negative-going signal on IC3(9). The signal on IC3(14) makes a rather quick positive excursion, is stretched by R56 and C24, and follows a ramp back down to its quiescent level of approximately −1.8 V. IC3(3) has a negative-going signal that feeds directly to IC3(4). IC3(2) remains at approximately −I.7 V until there is one gate propagation delay from the time that the negative signal appeared at IC3(4). The positive- going excursion on IC3(2) is fed to IC3(13) where it has no effect, since IC3(12) has already returned to its −1.0-V quiescent state. The signal at IC3(2) is translated through Q9, Q10, and Q11 and is then applied as a TTL signal to IC4(3). IC4 is a retriggerable monostable multivibrator. The timing for the multivibrator is externally controlled by varying the capacitance between pins 11 and 13 of IC4. C26, C27, C28, or C29 may be chosen by the front panel rate monitor switch S2. The signals on IC4(6) and IC4(8) are stretched and fed to IC5(10) and IC5(7), respectively. IC5(5) receives the clock signal from the emitter of Q11. The clear signal is taken directly from IC4(8). The Q output of IC5 [IC5(9)] drives Q12 through R69. The signal monitor output is taken from the emitter of Q12 through R72 and is available at the CN5 BNC connector on the rear panel. The front panel rate monitor test point TP3 is taken from the emitter of Q12 through R71.

The operation of the rate monitor circuit is briefly as follows: The rate monitor signal level is normally approximately 0 V to ±0.2 V when the discriminator repetition rate is below the rate monitor switch setting. The rate monitor output level rises to approximately 2 V when the discriminator repetition rate equals or exceeds the rate monitor switch setting.

5. MAINTENANCE

5.1. CORRECTIVE MAINTENANCE

The ORTEC 9302 should require no regular maintenance other than replacement of components that have failed due to age. Always ensure that the replacement components are equivalent to the original parts, designated in schematic 9302-0101-S1. No internal trimming or adjustment is necessary with the 9302.

To aid in the identification of a malfunctioning component, typical stage-by-stage dc voltages are shown in Table 5.1. These voltages are typical values, and may vary through a narrow range without indicating a fault.

5.2. FACTORY REPAIR SERVICE

This instrument can be returned to the ORTEC factory for service and repair at a nominal cost. Our standard procedure for repair ensures the same quality control and checkout that are used for a new instrument. Always contact the Life Sciences Division at ORTEC, (615) 482-4411, before sending in an instrument for repair for shipping instructions and so that the required Return Authorization Number can be assigned to the unit. This number should be written on the address label and on the package.

Table 5.1. dc Bias Points (Nominal Values).

Test Point		Voltage (V)	Test Point	Voltage (V)
Q1	B	0	Q26 B	−1.2
	E	−0.7	E	−1.5
Q2	B	0	Q28 B	−1.2
	E	−0.7	E	−1.5
Q4	B	+0.7	IC1(10)	−1.25
	E	0	IC1(11)	−1.25
Q5	B	0	IC1(14)	−1.2
	E	−0.7	IC1(15)	−1.6
Q6	B	0	IC1(2)	−1.6
	E	−0.7	IC1(3)	−0.8
Q8	B	+0.7	IC3(12)	−1.1
	E	0	IC3(13)	−1.6
Q15	B	−5.6	IC3(9)	−0.8
	E	−6.3	IC3(15)	−1.6
Q21	B	−0.05	IC3(6)	−1.6
	E	−0.75	IC3(3)	−0.8
Q22	B	−0.25	IC3(8)	−5.2
	E	−0.75	IC4(14)	5.0
Q23	B	5.6	IC4(7)	0
	E	6.0	IC5(4)	5.0
Q24	B	5.3	IC5(11)	0
	E	6.0		

6. APPLICATIONS

There are a number of different applications for the 9302 Amplifier-Discriminator. However, since the unit was designed primarily for ion, electron, and photon counting, system block diagrams for this type of usage are given.

Figure 6.1 is a block diagram of a system that might be used to perform atomic or molecular fluorescence measurements. Pulses from the photomultiplier tube are applied to the 9302, where they are first amplified. Following

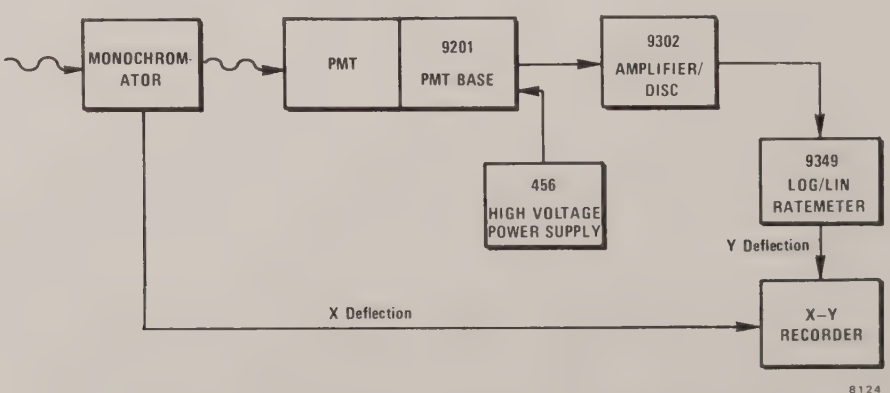

Fig. 6.1. Block Diagram of a Typical 1 MHz Ratemeter System.

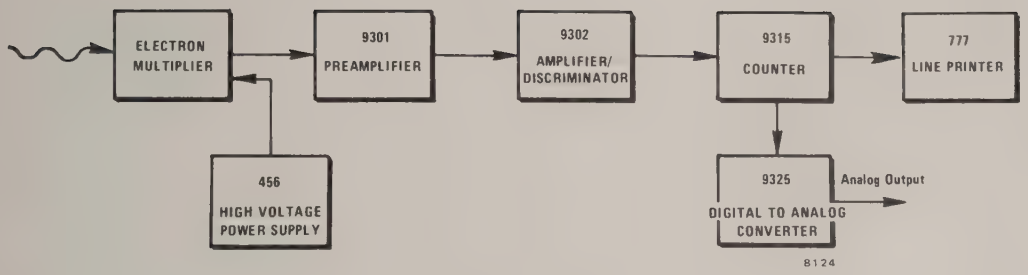

Fig. 6.2. Ion Counting System with Digital and Analog Outputs.

amplification, the pulses enter the discriminator section of the 9302, where those pulses whose amplitudes correspond to photons are accepted. Pulses that correspond to inter-dynode noise are of a lower voltage amplitude and are rejected. The discriminator output is then applied to the ORTEC 9349 Log/Lin Ratemeter. The 9349 measures the average count rate of the input pulses and also provides an analog output for the y-deflection of the x-y recorder.

An analogous application to low-level light measurements is ion counting. This technique can be applied to mass spectrometry, and has the same sensitivity advantages with an electron or ion multiplier that are obtained by other detectors such as photomultiplier tubes. A typical system that could be used is shown in Fig. 6.2.

APPENDIX

REPLACEABLE PARTS

ORDERING INFORMATION

The Replaceable Parts List shown below contains information needed for ordering spare and/or replacement parts. Each listing indicates the reference designator number, the part number, a description of the component, and the part manufacturer and manufacturer's part number.

All inquiries concerning spare and/or replacement parts and all orders for same should include the model serial, and revision ("Rev" on rear panel) numbers of the instruments involved and should be addressed to the Customer Service Department at 100 Midland Road, Oak Ridge, Tennessee 37830. The Manager of Customer Services can be reached by telephone at (615) 482-4411. The minimum order for spare and/or replacement parts is $25.00.

ORDERING INFORMATION FOR PARTS NOT LISTED

In order to facilitate the ordering of a part not listed below, the following information should be submitted to the Customer Service Department:

1. the instrument model number,
2. the instrument serial number,
3. revision ("Rev" on rear panel) number,
4. a description of the part,
5. information as to the function and location of the part.

The solid-state-device (diodes, transistors, and integrated circuits) types installed in your instrument may differ from those shown in the schematic diagram and parts list. In such cases, necessary replacements can be made with either the type shown or the type actually installed in the instrument.

Replaceable Parts List

9302-0100 9302-0100 CHAS ASM

REFDES	PART NUMBER	DESCRIPTION
	9 097 429340	MOD MALE SHIELD WIN 111-20853-1
	9 097 429350	MOD SHIELD BLOCK WIN 111-20851-1
	9 097 429370	GUIDE SOCKET WIN 111-20856-1
	9 097 429360	MOD GUIDE PIN WIN 111-20855 EE89
	9 097 429380	CONTACT PIN DOUBLE WIN 100-0811P
BNC1	9 097 413390	CON DGE UG 1094/U W/NT-34 PLAT
BNC2	9 097 413390	CON DGE UG 1094/U W/NT-34 PLAT
BNC3	9 097 413390	CON DGE UG 1094/U W/NT-34 PLAT
BNC4	9 097 413390	CON DGE UG 1094/U W/NT-34 PLAT
BNC5	9 097 413390	CON DGE UG 1094/U W/NT-34 PLAT
R1	9 027 404840	51.1 OHM MF 1/8W 1% CGW C-4 T-0
R128	9 047 435780	10 KOHM 20T CER TPT SPT 43Y-R10K
S1	9 094 642400	SL SW TANDEM DPDT SEC 47206LCR
S2	9 094 444540	SW ROTARY DP4T OAK 273606-A1

9302-0200 9302-0200 PC BD ASM

REFDES	PART NUMBER	DESCRIPTION
C1	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C2	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C3	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C4	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C5	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C6	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C7	9 057 408780	2.2 PF 5% 1KV DISC SPR 10TCC-V22
C8	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C9	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C10	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C11	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C12	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C13	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C14	9 059 408920	470 PF MIC 5% 500V ARC DM15-471J
C15	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C16	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C17	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C18	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2

9302-0200 9302-0200 PC BD ASM

REFDES	PART NUMBER	DESCRIPTION
C19	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C20	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C21	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C22	9 059 471530	5 PF DM ARC DM15-050D
C23	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C24	9 059 408860	100 PFMIC 2% 500V ARC DM15-101G
C25	9 059 408950	1000 PF MIC2% 100V ARC DM15-102G
C26	9 059 408880	180 PF MIC 5% 500V ARC DM15-181J
C27	9 060 468870	2200 PFMIC 2% ARC DM19222G TC-F
C28	9 061 409210	.022UF 10%200V MYL SPR 192P22392
C29	9 061 409250	0.22 UFMYL 10% 200V SPR192P22492
C30	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C31	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C32	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C33	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C34	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C35	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C36	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C37	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C38	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C39	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C40	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C41	9 059 417010	10 PF MIC 5% 500V ARC DM15-100J
C42	9 057 408740	12 PF 5% 1KV DISC SPR 10TCC-Q12
C43	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C44	9 065 495410	27 UF 15V TAN DCK D27GS815M
C45	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C46	9 065 409480	6.8 UF 20% 35V SPR150D685X0035B2
C47	9 071 489970	270 PF 50V ERC 1034-00-271P
C48	9 065 409480	6.8 UF 20% 35V SPR150D685X0035B2
C49	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C50	9 065 409480	6.8 UF 20% 35V SPR150D685X0035B2
C51	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C52	9 060 468570	1000 PFMIC 5% ARC DM15-102J TC-F
C53	9 060 468570	1000 PFMIC 5% ARC DM15-102J TC-F
C54	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C55	9 055 408550	.01UF 20%50V DI SPRC023K101F103M

Replaceable Parts List (continued)

9302-0200 9302-0200 PC BD ASM

REFDES	PART NUMBER	DESCRIPTION
C56	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C57	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C58	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C59	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C60	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C61	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C62	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C63	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C64	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C65	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C66	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C67	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C68	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C69	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C70	9 059 471520	3 PF 10% SM ARC/SEC SCDM15-030J
C71	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C72	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C73	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C74	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C75	9 055 408550	.01UF 20%50V DI SPRC023K101F103M
C76	9 065 409480	6.8 UF 20% 35V SPR150D685X0035B2
C77	9 059 417010	10 PF MIC 5% 500V ARC DM15-100J
C78	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C79	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C80	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
C81	9 065 409420	1 UF 20% 35V SPR 150D105X0035A2
D1	9 080 442170	DIODE 75V SYL 1N4153
D2	9 080 442170	DIODE 75V SYL 1N4153
D3	9 080 442170	DIODE 75V SYL 1N4153
D4	9 080 442170	DIODE 75V SYL 1N4153
D5	9 080 442170	DIODE 75V SYL 1N4153
D6	9 080 442170	DIODE 75V SYL 1N4153
D7	9 080 442170	DIODE 75V SYL 1N4153
D8	9 080 442170	DIODE 75V SYL 1N4153
D9	9 080 442170	DIODE 75V SYL 1N4153
D10	9 080 602020	FD-777 DIODE FSC %SPECIAL)
D11	9 080 411060	DIODE GLI 1N752A
D12	9 080 602380	DIODE FAST 20MA A306735 TD GRN
D13	9 080 411060	DIODE GLI 1N752A
D14	9 080 411060	DIODE GLI 1N752A
DL1	9 147 418750	COAX BRK RG174/U
IC1	9 079 604670	IC - MC10115 MOT
IC3	9 079 495300	IC-MC10102 MOT
IC4	9 079 637460	IC - 9601PC FSC
IC5	9 079 495030	IC - SN7473N NSC
L1	9 090 611770	FERROXCUBE FEX VK200 10/3B
L2	9 090 611410	BEAD FEX 56-590-65/4A6
L3	9 090 611770	FERROXCUBE FEX VK200 10/3B
L4	9 090 611770	FERROXCUBE FEX VK200 10/3B
L5	9 090 611410	BEAD FEX 56-590-65/4A6
L6	9 092 412460	100 UH WEE DUCTOR NTC 5%
L7	9 145 480910	WIRE #22 ENAMEL
L8	9 092 412460	100 UH WEE DUCTOR NTC 5%
L9	9 090 611410	BEAD FEX 56-590-65/4A6
L10	9 090 611410	BEAD FEX 56-590-65/4A6
L11	9 090 611410	BEAD FEX 56-590-65/4A6
L12	9 090 611410	BEAD FEX 56-590-65/4A6
L13	9 090 611410	BEAD FEX 56-590-65/4A6
Q1	9 078 478730	TRANS-2N5179 SEL FM 43659 RED
Q2	9 078 478730	TRANS-2N5179 SEL FM 43659 RED
Q3	9 078 436440	TRANS 2N4260 MOT EG&G AB0329-4
Q4	9 078 478210	TRANS-FMT5954 FSC
Q5	9 078 478730	TRANS-2N5179 SEL FM 43659 RED
Q6	9 078 478730	TRANS-2N5179 SEL FM 43659 RED
Q7	9 078 436440	TRANS 2N4260 MOT EG&G AB0329-4
Q8	9 078 478210	TRANS-FMT5954 FSC
Q9	9 078 436590	TRANS-2N5179 MOT %304840)
Q10	9 078 436590	TRANS-2N5179 MOT %304840)
Q11	9 078 436550	TRANS MOT MPS-6531
Q12	9 078 436550	TRANS MOT MPS-6531
Q13	9 078 478550	TRANS-MPS3640 SEL FM43652 TAN
Q14	9 078 478550	TRANS-MPS3640 SEL FM43652 TAN
Q15	9 078 478440	MPS2369 TRANSISTOR MOT SPS1467K
Q16	9 078 478600	2N3904 TRANSISTOR MOT
Q17	9 078 410700	TRANS-2N3053 RCA
Q18	9 078 436500	TRANS MOT MPS-6534
Q19	9 078 436880	TRANS-2N4036 RCA
Q20	9 078 436550	TRANS MOT MPS-6531

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REFDES	PART NUMBER	DESCRIPTION
Q21	9 078 478730	TRANS-2N5179 SEL FM 43659 RED
Q22	9 078 478730	TRANS-2N5179 SEL FM 43659 RED
Q23	9 078 478550	TRANS-MPS3640 SEL FM43652 TAN
Q24	9 078 478550	TRANS-MPS3640 SEL FM43652 TAN
Q25	9 078 478730	TRANS-2N5179 SEL FM 43659 RED
Q26	9 078 478730	TRANS-2N5179 SEL FM 43659 RED
Q27	9 078 478730	TRANS-2N5179 SEL FM 43659 RED
Q28	9 078 478730	TRANS-2N5179 SEL FM 43659 RED
Q29	9 078 478440	MPS2369 TRANSISTOR MOT SPS1467K
Q30	9 078 478440	MPS2369 TRANSISTOR MOT SPS1467K
R2	9 027 404840	51.1 OHM MF 1/8W 1% CGW C-4 T-0
R3	9 027 404840	51.1 OHM MF 1/8W 1% CGW C-4 T-0
R4	9 015 402020	10 OHM CC 1/4W 5% ABC CB
R5	9 027 405200	1.78 KOHM MF 1/8W 1% IRC CEA T-0
R6	9 027 405160	1.15 KOHM MF 1/8W 1% IRC CEA T-0
R7	9 015 402020	10 OHM CC 1/4W 5% ABC CB
R8	9 015 402020	10 OHM CC 1/4W 5% ABC CB
R9	9 027 405090	464 OHM MF 1/8W 1% IRC CEA T-0
R10	9 027 404840	51.1 OHM MF 1/8W 1% CGW C-4 T-0
R11	9 015 402550	47 KOHM CC 1/4W 5% ABC CB
R12	9 051 437430	20 KOHM CER TPT BEK 89P-R20K
R13	9 027 405090	464 OHM MF 1/8W 1% IRC CEA T-0
R14	9 027 405160	1.15 KOHM MF 1/8W 1% IRC CEA T-0
R15	9 015 402020	10 OHM CC 1/4W 5% ABC CB
R16	9 027 405100	511 OHM MF 1/8W C4 T-0
R17	9 027 405200	1.78 KOHM MF 1/8W 1% IRC CEA T-0
R18	9 015 402260	1 KOHM CC 1/4W 5% ABC CB
R19	9 027 404840	51.1 OHM MF 1/8W 1% CGW C-4 T-0
R20	9 027 404840	51.1 OHM MF 1/8W 1% CGW C-4 T-0
R21	9 015 402020	10 OHM CC 1/4W 5% ABC CB
R22	9 027 405180	1.33 KOHM MF 1/8W 1% IRC CEA T-0
R23	9 027 405850	1.10 KOHM MF 1/8W 1% IRC CEA T-0
R24	9 015 402020	10 OHM CC 1/4W 5% ABC CB
R25	9 015 402020	10 OHM CC 1/4W 5% ABC CB
R26	9 027 405090	464 OHM MF 1/8W 1% IRC CEA T-0
R27	9 027 404810	10 OHM MF 1/8W 1% IRC CEA T-0
R28	9 015 402260	1 KOHM CC 1/4W 5% ABC CB
R29	9 015 402020	10 OHM CC 1/4W 5% ABC CB
R30	9 027 404960	196 OHM MF 1/8W 1% IRC CEA T-0
R31	9 051 437430	20 KOHM CER TPT BEK 89P-R20K
R32	9 027 405210	1.54 KOHM MF 1/8W 1% IRC CEA T-0
R33	9 015 402020	10 OHM CC 1/4W 5% ABC CB
R34	9 017 403160	150 OHM CC 1/2W 5% ABC EB
R35	9 015 402710	51 OHM CC 1/4W 5% ABC CB
R36	9 030 623110	150 OHM 1/2 WATT 1% MF
R37	9 027 404840	51.1 OHM MF 1/8W 1% CGW C-4 T-0
R38	9 027 404840	51.1 OHM MF 1/8W 1% CGW C-4 T-0
R39	9 027 405310	3.83 KOHM MF 1/8W 1% CGW C4 T-0
R40	9 015 402020	10 OHM CC 1/4W 5% ABC CB
R41	9 030 623550	499 OHMS 1/2 WATT 1% MF
R42	9 027 404840	51.1 OHM MF 1/8W 1% CGW C-4 T-0
R43	9 027 405020	316 OHM MF 1/8W 1% CGW C-4 T-0
R44	9 027 405260	2.43 KOHM MF 1/8W 1% IRC CEA T-0
R45	9 015 402040	22 OHM CC 1/4W 5% ABC CB
R46	9 027 404950	75 OHM MF 1/8W 1% IRC CEA T-0
R47	9 051 437560	100 OHM 10T TPT BEK 89P-R100
R48	9 015 402240	820 OHM CC 1/4W 5% ABC CB
R49	9 027 405110	562 OHM MF 1/8W 1% IRC CEA T-0
R51	9 015 402040	22 OHM CC 1/4W 5% ABC CB
R52	9 015 402940	75 OHM CC 1/4W 5% ABC CB
R53	9 027 404860	82.5 OHM MF 1/8W 1% IRC CEA T-0
R54	9 015 402450	10 KOHM CC 1/4W 5% ABC CB
R55	9 015 402450	10 KOHM CC 1/4W 5% ABC CB
R56	9 015 402450	10 KOHM CC 1/4W 5% ABC CB
R57	9 015 402450	10 KOHM CC 1/4W 5% ABC CB
R58	9 015 402450	10 KOHM CC 1/4W 5% ABC CB
R59	9 027 437060	31.6 OHM MF 1/8W 1% IRC CEA T-0
R60	9 027 405350	5.62 KOHM MF 1/8W 1% IRC CEA T-0
R61	9 027 405150	1 KOHM MF 1/8W 1% IRC CEA T-0
R62	9 027 405450	10 KOHM MF 1/8W 1% IRC CEA T-0
R63	9 027 405110	562 OHM MF 1/8W 1% IRC CEA T-0
R64	9 015 402290	1.5 KOHM CC 1/4W 5% ABC CB
R65	9 027 405480	13.3 KOHM MF 1/8W 1% IRC CEA T-0
R66	9 015 402090	100 OHM CC 1/4W 5% ABC CB
R67	9 015 402090	100 OHM CC 1/4W 5% ABC CB
R68	9 015 402190	470 OHM CC 1/4W 5% ABC CB
R69	9 015 402260	1 KOHM CC 1/4W 5% ARC CB
R70	9 015 402450	10 KOHM CC 1/4W 5% ARC CB

Replaceable Parts List (continued)

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REFDES	PART NUMBER	DESCRIPTION
R71	9 015 402190	470 OHM CC 1/4W 5% ABC CB
R72	9 015 402260	1 KOHM CC 1/4W 5% ABC CB
R73	9 015 402760	1.6 KOHM CC 1/4W 5% ABC CB
R74	9 015 402460	12 KOHM CC 1/4W 5% ABC CB
R75	9 015 402110	150 OHM CC 1/4W 5% ABC CB
R76	9 015 402710	51 OHM CC 1/4W 5% ABC CB
R77	9 015 402040	22 OHM CC 1/4W 5% ABC CB
R78	9 015 402210	620 OHM CC 1/4W 5% ABC CB
R79	9 015 402300	1.8 KOHM CC 1/4W 5% ABC CB
R80	9 051 437440	2 KOHM CER TPT BEK 89P-R2K
R81	9 015 402260	1 KOHM CC 1/4W 5% ABC CB
R82	9 015 402090	100 OHM CC 1/4W 5% ABC CB
R83	9 015 402230	750 OHM CC 1/4W 5% ABC CB
R84	9 027 404970	215 OHM MF 1/8W 1% IRC CEA T-0
R85	9 027 404970	215 OHM MF 1/8W 1% IRC CEA T-0
R86	9 015 402310	2 KOHM CC 1/4W 5% ABC CB
R87	9 015 402320	2.2 KOHM CC 1/4W 5% ABC CB
R88	9 017 403010	100 OHM CC 1/2W 5% ABC EB
R89	9 015 402380	4.7 KOHM CC 1/4W 5% ABC CB
R90	9 027 405800	17.8 KOHM MF 1/8W 1% IRC CEA T-0
R91	9 015 402450	10 KOHM CC 1/4W 5% ABC CB
R92	9 027 405950	4.75 KOHM MF 1/8W 1% IRC CEA T-0
R93	9 015 402390	5.1 KOHM CC 1/4W 5% ABC CB
R94	9 017 443410	51 OHM 1/2W 5% ABC EB
R95	9 015 402390	5.1 KOHM CC 1/4W 5% ABC CB
R96	9 027 405370	6.81 KOHM MF 1/8W 1% CGW C4 T-0
R97	9 027 405350	5.62 KOHM MF 1/8W 1% IRC CEA T-0
R98	9 015 402190	470 OHM CC 1/4W 5% ABC CB
R99	9 027 405010	287 OHM MF 1/8W 1% CGW C4 T-0
R100	9 027 405530	21.5 KOHM MF 1/8W 1% IRC CEA T-0

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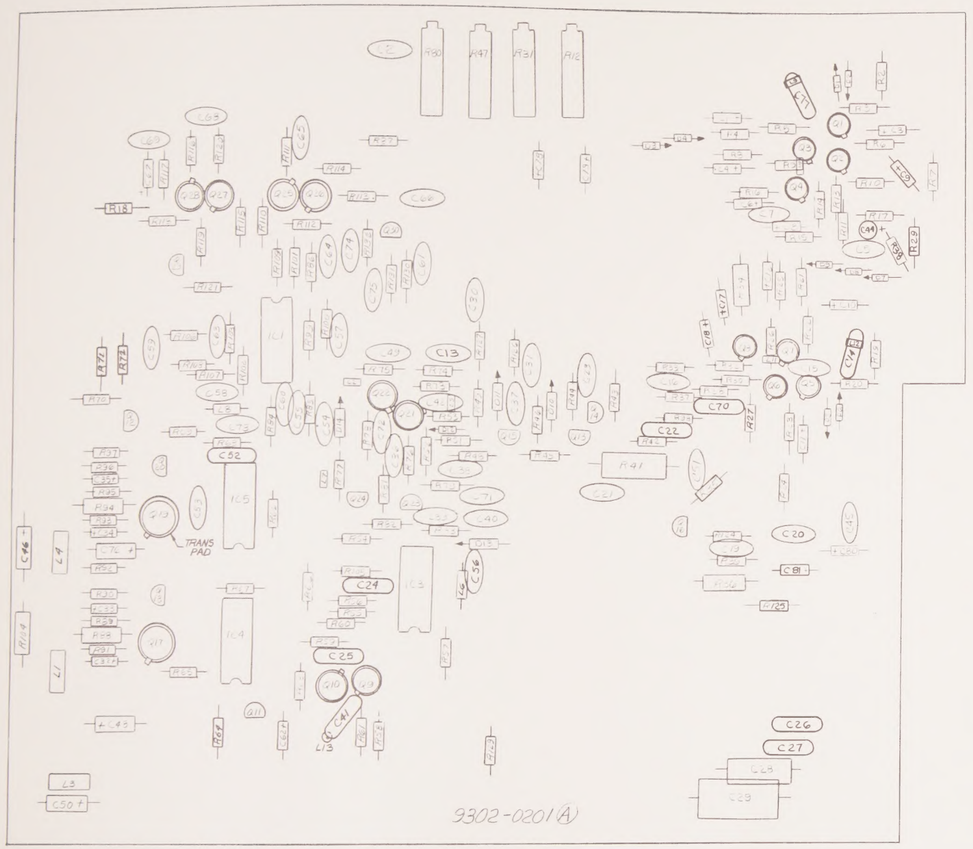
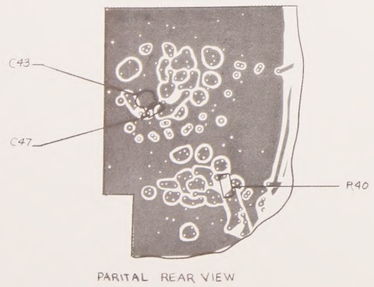
REFDES	PART NUMBER	DESCRIPTION
R101	9 015 402340	2.7 KOHM CC 1/4W 5% ABC CB
R102	9 027 404970	215 OHM MF 1/8W 1% IRC CEA T-0
R103	9 015 402690	180 OHM CC 1/4W 5% ABC CB
R104	9 036 638430	130 OHM WW 3W 5%
R105	9 027 405300	3.48 KOHM MF 1/8W 1% CGW C4 T-0
R106	9 015 402330	2.4 KOHM CC 1/4W 5% ABC CB
R107	9 027 404860	82.5 OHM MF 1/8W 1% IRC CEA T-0
R108	9 027 404910	133 OHM MF 1/8W 1% IRC CEA T-0
R109	9 015 402280	1.2 KOHM CC 1/4W 5% ABC CB
R110	9 015 402170	27 OHM CC 1/4W 5% ABC CB
R111	9 027 405680	604 OHM MF 1/8W 1% IRC CEA T-0
R112	9 015 402020	10 OHM CC 1/4W 5% ABC CB
R113	9 015 402170	27 OHM CC 1/4W 5% ABC CB
R114	9 015 402020	10 OHM CC 1/4W 5% ABC CB
R115	9 015 402170	27 OHM CC 1/4W 5% ABC CB
R116	9 027 405540	536 OHM MF 1/8W 1% IRC CEA T-0
R117	9 015 402170	27 OHM CC 1/4W 5% ABC CB
R118	9 015 402020	10 OHM CC 1/4W 5% ABC CB
R119	9 015 402020	10 OHM CC 1/4W 5% ABC CB
R120	9 015 402020	10 OHM CC 1/4W 5% ABC CB
R121	9 027 404910	133 OHM MF 1/8W 1% IRC CEA T-0
R124	9 027 405230	2.15 KOHM MF 1/8W 1% IRC CEA T-0
R125	9 015 439490	2.7 OHM CC 1/4W 5% ABC CB
R126	9 015 439490	2.7 OHM CC 1/4W 5% ABC CB
R127	9 015 439490	2.7 OHM CC 1/4W 5% ABC CB
R129	9 015 439490	2.7 OHM CC 1/4W 5% ABC CB
R130	9 027 405020	316 OHM MF 1/8W 1% CGW C-4 T-0
R131	9 027 405350	5.62 KOHM MF 1/8W 1% IRC CEA T-0
R132	9 027 437100	5.23 KOHM MF 1/8W 1% IRC CEA T-0



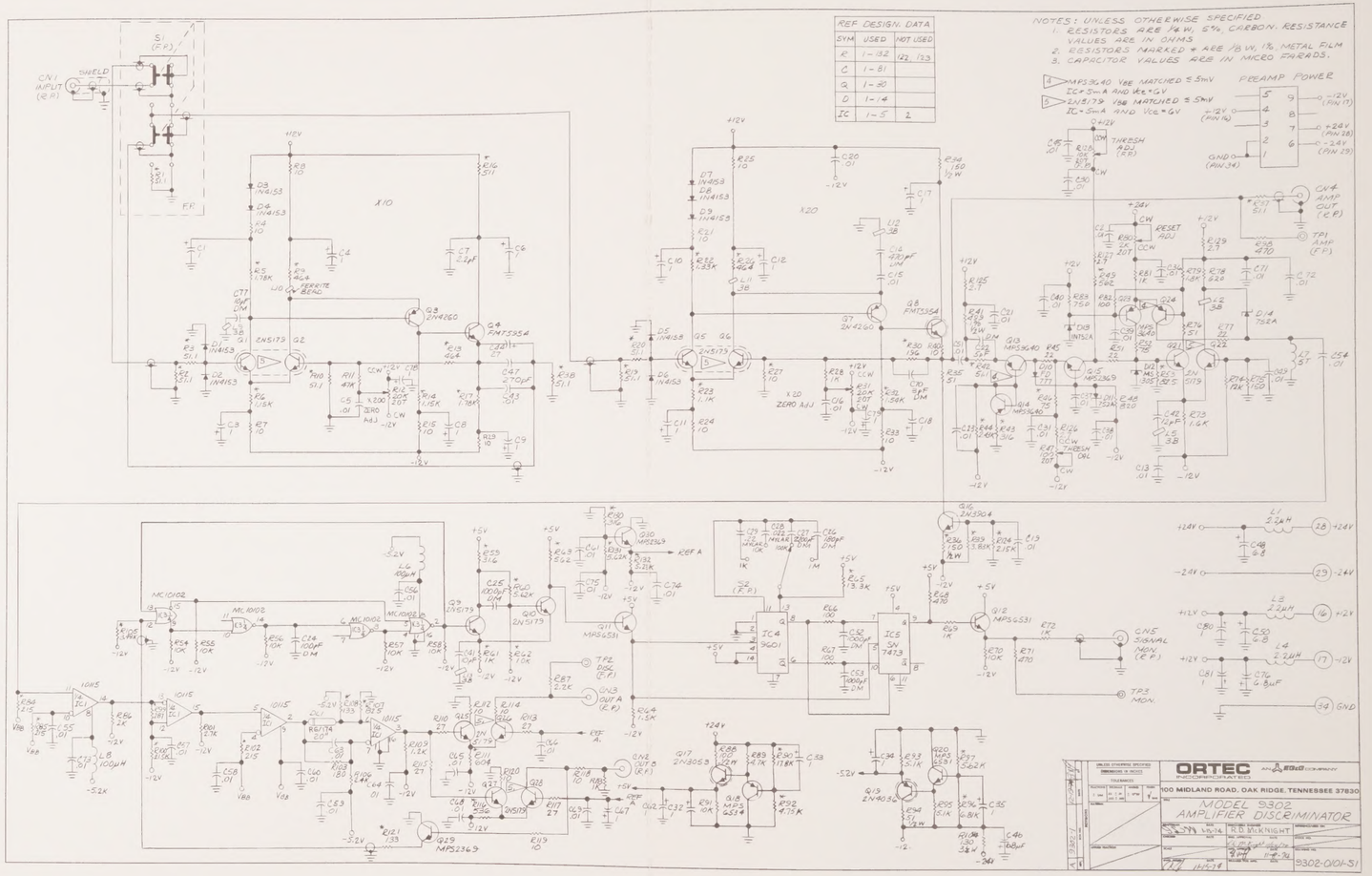


PARITAL REAR VIEW

REF. DESIGN. DATA		
SYM	USED	NOT USED
R	1 - 132	142, 143
C	1 - 81	
Q	1 - 30	
D	1 - 14	
IC	1 - 5	2

NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTORS ARE ¼ W, 5%, CARBON. RESISTANCE VALUES ARE IN OHMS
2. RESISTORS MARKED * ARE ⅛ W, 1% METAL FILM
3. CAPACITOR VALUES ARE IN MICRO FARADS.

PREAMP POWER



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